

In re Application of: Yair Ein-Eli et al.
Serial No.: 10/551,714
Filed: July 20, 2006
Office Action Mailing Date: May 13, 2010

Examiner: PARVINI, Pegah
Group Art Unit: 1793
Confirmation No. 6188
Attorney Docket: 30579

REMARKS

Reconsideration of the above-identified application in view of the amendments above and the remarks following is respectfully requested.

Claims 1-59 are pending in this case. Claims 31-52 and 54 have been withdrawn from further consideration as being drawn to a non-elected invention. Claims 23-25 have been previously canceled. Claims 1-22, 26-30, 53 and 55-59 have been examined on the merits.

Claims 1-22, 26-30, 53 and 55-59 have been rejected under 35 U.S.C. § 103. Claim 1 has been amended herewith.

Interview Summary

Applicant wishes to thank the Examiner for her kind attention during the Telephone Interview held On October 21, 2010 and for the remarks provided during said Interview.

In the Telephone Interview, MPEP § 2144.05-based rejections regarding overlapping range raised by the Examiner in the outstanding Office Action have been discussed and MPEP § 2111.02-based preamble rejections were also discussed.

Specifically, Applicant has pointed out that according to MPEP § 2144.05, showing a criticality of a claimed range should circumvent a *prima facie* case of obviousness. Applicant has pointed out that the showing of such a criticality is found on Figure 1 and accompanying discussion on page 10 of the instant application. The Examiner has stated in response that she will consider the showing of criticality as overcoming the obviousness rejections.

With regard to distinctive limitations that relate to the intended use of the composition, which were considered by the Examiner in the outstanding Office Action as not adding any patentable weight based on MPEP § 2111.02, Applicant has argued that MPEP § 2111.02 should be re-evaluated in view of the above-indicated criticality, which relates to the intended use, and has proposed cosmetic amendments to the claims in order to include an intended use within the claim limitation instead of within the preamble. The Examiner has stated that the amendments suggested by the Applicant do not seem to mitigate the rejections based on the preamble with regard to the intended use of the composition, yet, has further stated that this issue can be

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reevaluated in view of the argumentation presented in the issue of the critical pH range limitation and further in view of MPEP § 2111.02, since the indicated criticality relates to the intended use of the claimed composition.

The Examiner has also offered to contact the undersigned in case some of the argumentations presented below would be still found insufficient.

Amendment to the claims

Claim 1 has been amended so as to better define the claimed composition. Amended claim 1 reads on a composition that comprises a solution having a pH that ranges from 9 to 13, which, when applied to a copper-containing surface, oxidizes the copper to copper oxides such that neither the copper nor the copper oxides are soluble in the composition.

As argued hereinbelow, it is submitted that none of the cited art teach compositions which are characterized by the claimed features.

35 USC § 103 rejections

***Shimazu et al. ('064), Shimazu et al. ('188) and
Francis et al.***

The Examiner has stated that claims 1-9, 12-17, 19-22, 26-30, 53, and 55-59 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent Application Publication No. 2002/0117064 to Shimazu *et al.* ('064) and U.S. Patent Application Publication No. 2003/0153188 Shimazu *et al.* ('188), and that claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent Application Publication No. 2002/0117064 to Shimazu *et al.* ('064) or U.S. Patent Application Publication No. 2003/0153188 Shimazu *et al.* ('188), in view of Parker et al. (U.S. Patent Application Publication No. 2003/0212283).

The Examiner has further stated that claims 1-19, 26-30, 53, 55-57 and 59 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent Application Publication No. 2001/0051433 to Francis *et al.*.

The Examiner's rejections are respectfully traversed. Claim 1 has been amended herewith.

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The Examiner's rejections are discussed in the following with respect to the Examiner's statements regarding overlapping ranges and intended use.

For convenience purposes, U.S. Patent Application Publication No. 2002/0117064 to Shimazu *et al.* ('064) and U.S. Patent Application Publication No. 2003/0153188 Shimazu *et al.* ('188) are referred to herein as "the Shimazu *et al.* references".

Re.: Overlapping range

The Examiner has stated that that Shimazu *et al.* disclose a polishing composition having a pH of 5.5-10.0 and containing alkaline substances such as potassium carbonate, oxidizing agent such as potassium permanganate, abrasive grains such as silicon oxide, aluminum oxide, cerium oxide in an amount of preferably 0.1-20 or 1.0-10 weight percents. The Examiner has further stated that it is to be noted that a pH of 5.5-10 clearly has overlapping ranges with the claimed pH (9 to 13), and overlapping ranges have been held to establish *prima facie* obviousness.

With respect to Francis *et al.*, the Examiner has stated that Francis *et al.* disclose a chemical mechanical polishing solution having a pH of preferably greater than 9.0, at least one abrasive such as alumina, silica, ceria in an amount of from about 1.0 to about 50.0 weight percent, preferably from about 5.0 to about 25.0 wt%, and further comprising at least one Cs⁺ basic salt such as cesium carbonate, and optional components such as oxidizing agents. The Examiner further stated that a pH of preferably greater than 9.0 clearly has overlapping ranges with the claimed pH, and overlapping ranges have been held to establish *prima facie* obviousness.

In both cases, The Examiner has quoted MPEP § 2144.05.

In response, Applicant submits that embodiments of the present invention relate to a composition for controlled polishing of copper which is effected at non-corrosive conditions, namely under conditions in which copper and/or copper oxide do not dissolve, and the polishing is effected at mechanical erosive conditions. The disclosed composition has been designed based on the surprising findings that the pH of the composition is critical for achieving the desired effect; and this pH range correlates the composition to the substance of the substrate, namely correlates the composition to copper-containing substrates.

With reference to MPEP § 2144.05, Applicant respectfully submits that it is stated therein that when the claimed range is shown to be critical in achieving the unexpected results relative to the prior art range, there is **no** *prima facie* case of obviousness.

Applicant contends that the instant application contains ample description and experimental results to back the contention that the pH range of the claimed composition is indeed critical to obtain the desired, unexpected result. The Examiner's attention is kindly drawn in this regard to the passage on **page 10, line 17-21**, which opens the discussion on the underlining rational of the presently claimed CMP slurries. This passage speaks of the non-obvious analysis of the Pourbaix diagram (a potential/pH diagram) presented in **Figure 1** of the instant application, which maps out possible stable (equilibrium) phases of an aqueous electrochemical system of copper and other metals. The passage on **page 10, lines 22-28** presents the connection between the pH of the copper-containing system, and the sufficient oxidation potential for passivation of copper, which is then expressed by the equation presented on page 11, line 9, of the instant application.

The Examiner's attention is further directed to Figure 1, where it shown that at pH lower than 9, the formation of cuprum ions (Cu^{+2}), effective as copper dissolution, is observed, at pH between 9 and 13 the formation of a passivating layer of insoluble copper oxides, apparently CuO or Cu_2O , is observed, and at pH greater than 13, copper oxide dissolution as the formation of soluble cuprite ions (CuO_2^-) is observed. Thus, it is clearly shown in Figure 1 that the pH range of from 9 to 13 is critical for avoiding chemical (corrosive) dissolution of both copper and copper oxides and thus for achieving controllable mechanical (erosive) copper polishing.

The Examiner's attention is further directed to Applicant's arguments presented in response to previous office actions, with regard to the rational behind using a composition for polishing copper having a pH that ranges from 9 to 13, based on the non-trivial finding that below that pH range or above it the polishing composition is less effective due to copper or copper oxide dissolution which occurs outside that pH range, which is presented and discussed in the instant application.

Contrary to the claimed invention, the **Shimazu et al.** references are directed at providing compositions that exhibit a high rate of **polishing Ta or TaN** material

(see, paragraph [0021]) and a relatively lower rate of copper dissolution, in order to remove a barrier layer while trying to minimize the effect on copper nanowires. Shimazu *et al.* report to have carried out extensive studies so as to reduce the rate of copper erosion, and to have found that a polishing composition having a pH of 5.5-10.0, and more preferably 5.5-9.0, is suitable for polishing Ta or TaN material in LSI devices (see, paragraphs [0022-0023]). Shimazu *et al.* further disclose that a composition having a pH of 5.5-10.0, and more preferably 5.5-9.0, exhibits low corrosiveness and dissolution of copper (see, paragraph [0025]). The Shimazu *et al.* references thus teach that the dissolution rate of copper at the indicated pH range is low, yet dissolution occurs. Furthermore, while the Shimazu *et al.* references teach a pH range of 5.5-10.0, all the data demonstrated therein relates to pH of 7.0-9.0, and no experiments were actually performed at pH higher than 9.0.

Thus, while the Shimazu *et al.* references teach a pH range for achieving a low dissolution rate of copper, the Shimazu *et al.* references fail to teach, suggest or provide any motivation for using, pH values higher than 9 for achieving an even better performance, namely, avoiding copper and/or copper oxides dissolution.

It is therefore submitted herewith that (i) in the data and accompanying discussion presented in the instant application, the criticality of a composition having a pH of 9-13 is clearly demonstrated; (ii) the criticality of the pH range is demonstrated with respect to a pH range where no dissolution of copper and copper oxide occurs; (iii) the Shimazu *et al.* references teach that dissolution of copper occurs at a low rate at pH of 5.5-10; (iv) the Shimazu *et al.* reference fail to show or suggest a pH range where no dissolution of copper occurs; and (v) the Shimazu *et al.* references fail to show or suggest that at pH of 9-13, no dissolution of copper occurs.

Accordingly, it is submitted that since it is demonstrated in the instant application that the claimed pH range is critical for achieving a composition with a desired performance for polishing copper-containing substrates, no *prima facie* case of obviousness can be established in view of the teachings of the Shimazu *et al.* references, each alone, in combination, and further in view of Parker *et al.*.

With respect to **Francis *et al.***, Applicant's arguments follow the aforementioned arguments. Specifically, Applicant submits that Francis *et al.* is directed at **compositions for polishing silicon wafers**, and disclose that the pH of the

polishing composition should be greater than about 7.0 and preferably greater than about 9.0. Since this reference is not directed at CMP compositions for copper, Francis *et al.* are completely silent with respect to the problem of copper dissolution or to the reasons to limit the pH to the range of 9 to 13, as disclosed in the instant application, and is silent with respect to the criticality of the claimed pH range for achieving the desired results.

Accordingly, it is submitted that since Francis *et al.* teach compositions having a pH higher than 9 in general, Francis *et al.* fail to teach or provide any motivation to use the claimed composition, which has the claimed pH range. It is further submitted that since it is demonstrated in the instant application that the claimed pH range is critical for achieving a composition with a desired performance for CMP of copper, no *prima facie* case of obviousness can be established in view of the teachings of Francis *et al.*

Re.: Intended use (Recitation in the preamble and of a capability of the claimed invention)

With respect to both Shimazu *et al.* and Francis *et al.*, the Examiner has stated that the recitation of "for the formation of a passivating layer on a surface, the surface including more than 5 % copper by weight" is a recitation in the preamble, and quoted MPEP § 2111.02.

The Examiner has further stated that the recitation of "having an oxidation potential sufficient to oxidize the surface to form copper oxides" is taken to be a capability of the claimed composition.

Applicant respectfully submits that, as also implied by the Examiner's reference to the recitation in the preamble and to the capability of the claimed composition, it is clear that none of the cited documents teaches compositions that are directed at polishing copper-containing substrates.

However, Applicant respectfully submits that in view of the criticality discussed hereinabove of the claimed pH range of the claimed composition with respect to copper-containing substrates, a reference to "...the formation of a passivating layer on a surface, the surface including more than 5 % copper by

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weight", and to a composition "having an oxidation potential sufficient to oxidize the surface to form copper oxides" forms a part of the critical claimed pH range.

Applicant submits that in the MPEP § 2111.02 it is recited that:

"If the claim preamble, when read in the context of the entire claim, recites limitations of the claim, or, if the claim preamble is 'necessary to give life, meaning, and vitality' to the claim, then the claim preamble should be construed as if in the balance of the claim." Pitney Bowes, Inc. v. Hewlett-Packard Co., 182 F.3d 1298, 1305, 51 USPQ2d 1161, 1165-66 (Fed. Cir. 1999)."

and

*"During examination, statements in the preamble reciting the purpose or intended use of the claimed invention must be evaluated to determine whether the recited purpose or intended use results in a **structural difference** (or, in the case of process claims, manipulative difference) **between the claimed invention and the prior art**. If so, the recitation serves to limit the claim. See, e.g., In re Otto, 312 F.2d 937, 938, 136 USPQ 458, 459 (CCPA 1963)."*

Applicant contends that, as argued in detail hereinabove, since the claimed pH range of the composition achieves results with respect to copper and copper oxides dissolution, which are unexpected over the teachings of the Shimazu *et al.* documents and of Francis *et al.*, it is clear that the recitation in the preamble is at least "'necessary to give life, meaning, and vitality' to the claim".

Notwithstanding the above, it is submitted that amended claim 1, as presented herein, more clearly defines the effect of the claimed composition in the context of the indicated recitation and capability.

Conclusion

In view of the above amendments and remarks it is respectfully submitted that the claimed invention is now in condition for allowance. A prompt notice of allowance is respectfully and earnestly solicited.

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Prior to mailing of the Examiner's next Official Action, the Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

Respectfully submitted,

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Enclosures:

- Petition for Extension (3 Months)